REFRACTIONS

AN ALBEDO OMNIBUS

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The First Years

Steve Gallacci

In the years immediately after the Awakening on Arras Charka, there was a period of intense investigation into what, exactly, the population had awakened to. While a planet-wide AI net and vast technical database held many answers, half the task of the analysis teams was to come up with the right questions to ask, as the AI was not inclined to reveal the secrets of the universe too easily.

Actually, the AI net's knowledge turned out to be tantalizingly incomplete. While the AI knew how to maintain nuclear fusion reactors and could describe the details of the specific event, it did not know anything else about atomic phenomena or even the periodic table of elements. It contained the raw observed statistics of planetary motion but had no conclusions about gravity and celestial mechanics. In short, while it knew about recorded events, it largely had no knowledge of deeper questions of the how or why, and it insisted that the users be very specific if they wanted it to help them answer those questions.

To approach the issues, investigators established experimental centers both to test the existing database facts and explore the fundamental processes behind the recorded phenomena. These centers also examined and explored applications and techniques of the various sciences to gain a better understanding of the potentials available to the population.

An early breakthrough in the development phase, once the basics were established, was the use of virtual modeling. Creating virtual simulation programs allowed researchers to sift through countless possible arrangements of everything from improved-efficiency fusion reactors to the best shape for a really comfy chair. Along with simulating designs, the technology could test new materials and manufacturing techniques, creating engineered materials to match the new items. The often messy and sometimes dangerous fields of chemistry and bioscience leaped forward with molecular simulations which examined the hazards and potentials of new compounds and even genetic examination and manipulation. That potential was mostly held in check, used only for therapeutic gene adjustment, xenobiological research and defense.

As the knowledge base improved and the population had time to digest the ever-broadening view of their place in the universe, new goals were considered and debated. The issue of the people's own creation, especially of an extraplanetary origin, became a major point in the decision to pursue space exploration.

After a considerable amount of virtual modeling and basic research on everything from aerodynamics to metallurgy, small liquid-fuel chemical rockets were conceived and built with few problems, and suborbital probes were soon launched. Because of the limited nature of chemical rockets and aerospace planes (capsule-type spacecraft were never seriously considered), emphasis quickly turned to flight-capable fusion reactors.

Existing reactors were massive fixed installations and it would take some years to reduce the thousand-ton power plant into a thousand-kilo motor. As new reactors were being developed, the exact nature of a fusion rocket was being examined. For endo-atmospheric operations, a convertible air-breathing system was designed which used the atmosphere as part of the propulsion mass at low altitude - in this way, it was not unlike a ramjet - then ran as a pure fusion rocket in space. Such a motor took advantage of the atmosphere's free mass during take off and only needed to carry propulsion mass for in-space operations. Improved air-breathing fusion motors found their full potential in the wingless aerodyne which eventually filled operational roles from helicopter to space shuttle, while dedicated space-based fusion rockets made interplanetary travel easy.

With an economical launch system established, orbital space quickly became thick with manufacturing and research stations. Within twenty years of first reaching orbit, 10,000 people lived permanently in space, and within another twenty years, every body in local space, except the three gas giants, had people living and working on it.

Interstellar travel had to wait for quantum physics work to discover the reality phenomena that suggested alternate physical states, and by extension, alternate universes. By very controlled transitions through the physical states/universes, interstellar distances could be instantly leaped. Early trials often met with disastrous results, as the phenomena were not well-defined and could be tested only in the field, rather than in controlled lab experiments. Once established, however, the technology proved to be very reliable, and interstellar exploration - and later, colonization - became the passion of the age.

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Space

Steve Gallacci

The population of Arras Charka in the generations after the Awakening had been very busy making the most of the tools and resources available to them. So much so that it did not take all that long for them to not only develop interplanetary space travel, but have a large permanent population in space and on other worlds in the system.

Though the overall population had risen to nearly a half-billion and there was clearly enough room and material for many more for a very long time, concerns were raised about the long term future and the ultimate purpose of their existence. Social planners had been running simulations almost as soon as the notion of social planning was conceived, with variations of stagnation and eventual degeneration being the consistent outcomes. This was at odds with the philosophical arguments for doing nothing in particular and going nowhere yet social planners looking into the future didn't see any solution that wasn't as bad as the problem.

That changed with the discovery of the jump effect that allowed for interstellar distances to be crossed in an instant. Suddenly, the potential of the universe was at hand, igniting new debates. Now, literally seeking out the Creator was possible, if such could be found at all, as well as developing and colonizing neighboring stars. Purely philosophical objections were drowned out in the clamor to reach out to the rest of the galaxy, but new, more practical questions arose.

Jump itself was a new technology, and it would take more than a decade for the first piloted missions to be attempted. Though the process proved to be very reliable, there were risks. A badly set jump could destroy the ship outright, or subject it and the crew to effects similar to ionizing radiation exposure, and even jumps considered safe had cumulative effects that could effect genetic integrity.

Though the Arras Charkaii had been in space for a couple of generations by then, and the issues of low Gee/no Gee and closed system living had been well established, the prospect of alien biospheres had not been tested. The other worlds of the system had proved to be lifeless, and though there had been some protocols for biological exposure, there was real concern for either bringing back some hazard or devastating other worlds with an otherwise benign biological agent.

So, the first wave of interstellar exploration was done with waves of small robot probes that did simple "there and back again" reconnaissances of likely systems. Then as they came on line, large crewed ships went on grand tours of the systems, launching new waves of probes as they went. While hundreds of systems and thousands of planets were cataloged, no direct contact with any active biosphere was attempted, aside from some specially sterilized non-returnable robot mini-probes which examined potentially habitable worlds.

It would not be until high-power biological analyzers were developed that could assess both entire gene sequences (derived from genetic analysis and manipulation research, delving into the technologies suspected in their own creation) and extrapolate potential compatibility risks that might exist. This allowed previously surveyed planets to be deemed safe, landed upon and eventually colonized.

The initial colonization effort was a well-coordinated and closely managed affair to make sure no mistakes were made. Thorough biological surveys were done over several years to insure no likely life cyclic was missed, and the first generation population was kept small, but broad-based, and was well-monitored for potential problems.

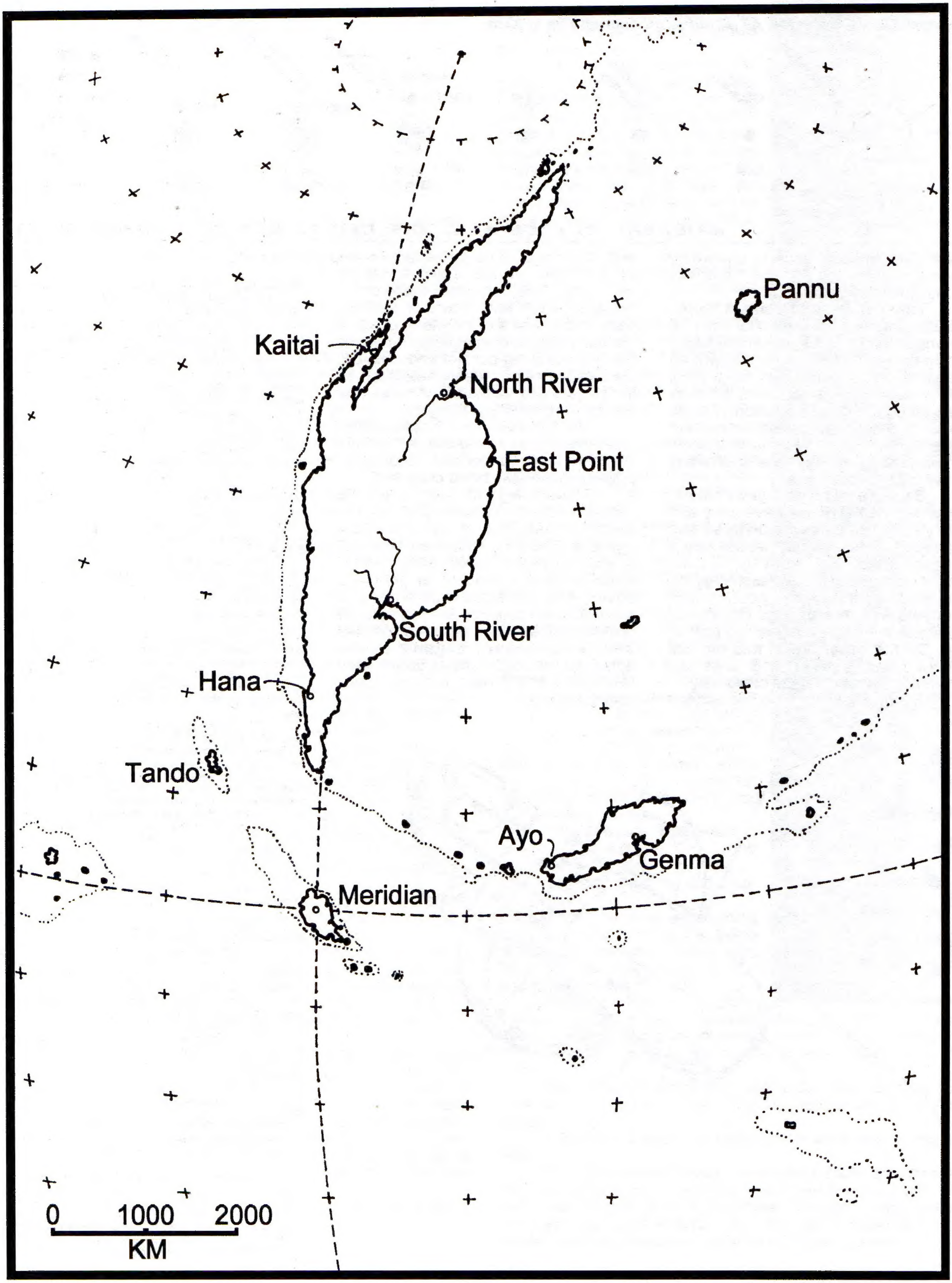
The infrastructure for the colonies were developed for the highest level of self-sufficiency, making the import of anything other than key tools and expertise unnecessary. After an initial probationary period, the colonies became sources of supply for further exploration and development.

The history of Aerandar, the first colonized world, is a good case in point.

The star had previously been cataloged as a candidate for further study by optical instruments in free orbit around Arras Prime and was on the short list of systems to be examined by crewed ships as it was out of range of the small and limited probes available. The UH4*, the first fully operational exploration starship would visit the system on its second voyage in SD 004 (the StarDate calendar started with the first mission of the UH4). The ship initially plunged through the Chalendar system, examining the various planets with long range sensors. As there was no indication that there was anyone to notice them, the ship then decelerated and established a high orbit around Chalendar Five. There, it examined the planet as thoroughly as remote sensing allowed while probes landed and analyzed the biosphere.

Chalendar Five, then named Aerandar, proved to have a excellent environment for colonization, with only limited terrestrial flora and no significant fauna to compete with agricultural efforts. Also, on a biochemical level, there was sufficient compatibility to pose no toxics risk, but not enough to have any immediate susceptibility to native bacteria or viruses. Biomass cultivation could be done with little preparation, and the natives were sufficiently well-established as to prevent uncontrolled spreading of non-natives.

The first crewed landing took place on SD 016-08-20, and within the year, the first permanent structures were erected. The first real permanent colonists would not arrive for another eight years, as there were many long-term environmental studies that needed to be done first. Without a moon and with little axial tilt or orbital eccentricity, there was no real change in seasons and the tides were very limited, so only the cycle of day and night provided any biological rhythm. As a result, it took some time to adapt and make clear baselines for entirely normal medical conditions. The long-term development


Pannu
Kaitai
North River
East Point
South River
Hana
Tando
Ayo
Genma
Meridian
0
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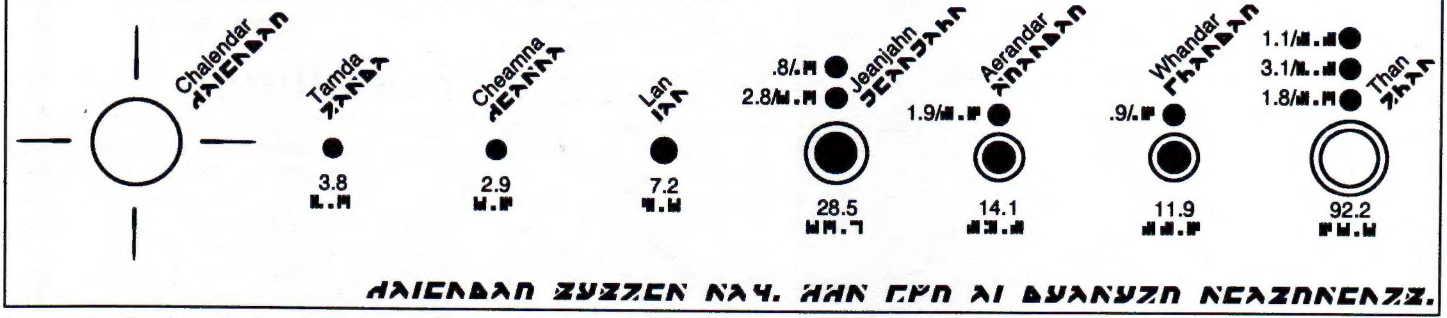
System Map, Chalandar. All diameter measurements in Kkm.



team also had a chance to intimately know the world and sort out the quirks of the environment.

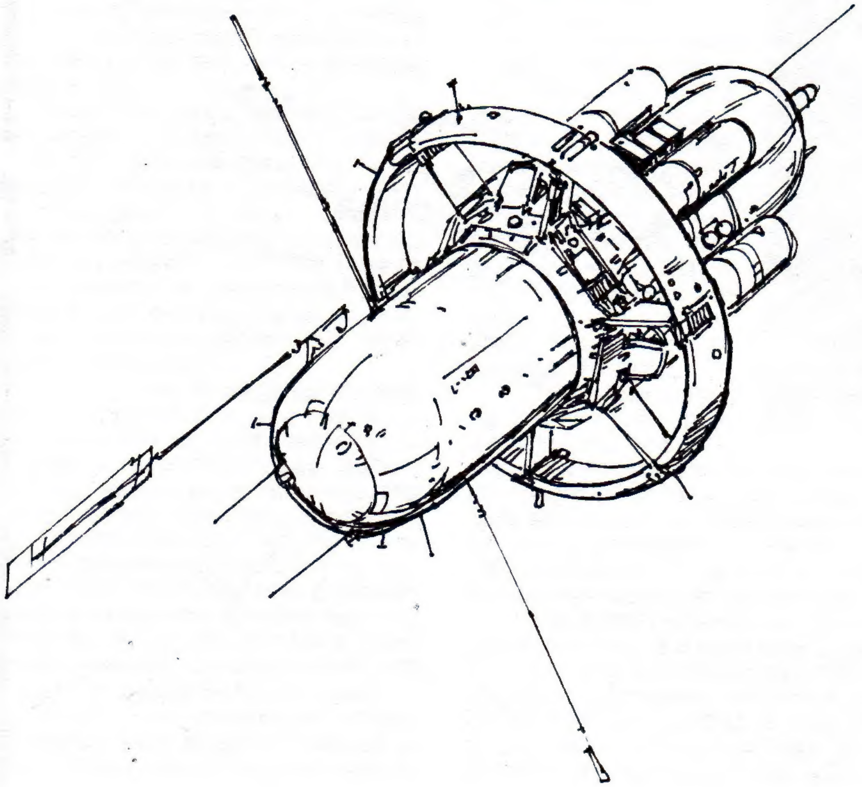
The first wave of settlers, some 12,000 people in all, built nine sites on the major landmasses and immediately set in to become as self-sufficient as possible. Not only did they bring tools and materials for production, but they also brought a good selection of extra genetic material and gene-management tools to insure that the various species would have a healthy range of diversity in their reproduction.

Because this was a government-run experimental project, everyone and everything was closely monitored and managed. This was not necessarily a burden as the colonists were all well-trained and dedicated professionals, so the air of clinical introspection and analysis became part of the social environment and an expected part of life. On the other hand, this did not mean that everything was an unemotional monument to conformity.

A broad base of expertise brought with it a range of outlooks, and while some basic points were fixed by necessity or arbitrary rules, many of the "what"s, "why"s and "how"s of both the daily procedures and long-term goals of the colony were continuously debated. Far from causing conflict and division, the debates helped "debug" elements of the project and ultimately created new consensus throughout the group.

The feedback also helped in the planning of future colonies, especially the more focused "second generation" projects that began being proposed.

These would be colonies established by private parties for specific economic or ceca-political agendas. The early ones were state co-sponsored, as the capital outlay was too much for any individual or group to cover, and the state was willing to subsidize the projects for the sake of diversity experiments. Later, as colonies and independent organizations amassed the resources to do so, they launched their own independent colonial efforts.



Detail of the Chalendar system

Chalendar is a hot yellow dwarf (somewhat hotter and more massive than Sol) thirty light years from Arras Charka. It has seven planets and they in turn have seven major moons. There are also six minor moons and several hundred asteroids in the system.

C1, Tamda, is a large rocky astroid caught in close orbit, apparently having wandered into the system from another star. It is not very dense and has settled into a stable, though very close orbit of the star without substantially perturbing the smaller but much more massive Cheamna. 3.8K km dia.

C2, Cheamna, is a small iron and heavy metal pellet of a planet, too close to the primary to have captured many lighter elements during the system's early formation. 2.9K km dia.

C3, Lan, is bigger than Cheamna and has a similar, though molten, massive core, but also has a lighter-element crust and is tectonically active. But being so close to Chalendar and its strong solar flux, outgassing from the many active volcanoes is swept away before any real atmosphere can be created. 7.2K km dia.

C4, Jeanjahn, has a large rocky/iron core and light-element crust and is very active. It also has seas and a thick, "greenhouse" gas atmosphere. Surface conditions are fierce, with temperatures just under boiling in seas of mineral soup and the air a highly reactive mess of hydrocarbons that goes through a complex evolution between the sunlit upper clouds and the dark and damp wave tops. Volcanoes that break the surface belch forth chemistries that have gone through their own metamorphosis in the fast-churning turnover of the surface materials that are worked by very hot and fluid mantle activity. 28.5K km dia.

Two major moons JM1/"Tebeas," at 3.8K km and JM2/"Bob," at 1.6K km orbit at a fair distance, along with two additional very small moonlets in low orbit, captured asteroids that will eventually de-orbit.

C5, Aerandar, though a bit further out than might be expected for a habitable world with the available starlight, has a thickish atmosphere and large seas that moderate temperatures and make for a very pleasant climate over the entire surface. The current major landmass is only a large island in the northern hemisphere, the bulk of the major continental plate is just below sea level, creating a great shallow sea over a quarter of the planet. Tectonic activity is slight, with only the occasional island-building volcano in the ocean basin providing obvious action. 14.1K km dia.

AM1/"Danaho" is a the single moon at moderate orbit. 1.9K km dia.

C6, Whandar, is a near companion to Aerandar, but being further from the primary and having less of an atmosphere to maintain surface temperatures, is an ice-covered planet with little else on the surface. There is limited life in the deep basins warmed by geothermal activity, though there is evidence of a warmer period when the planet had a thicker atmosphere and a fairly well-developed ecology. 11.9K km dia.

WM1, Jumda is a small moon that has a close orbit. 972 km dia.

C7, Tahn, is a gas giant with a rocky/light element core and very thick atmosphere. 92.2K km dia. Moons include TM1/"Fadon," 1.8K km dia.; TM2/"Muabi," 3.1K km dia.; and TM3/"M415," 1.1K km dia., as well as at least four captured small asteroids in orbit and Trojan point asteroid groups.

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* **UH** stood for Unoth Hikeah, borrowed from Poul Anderson's *Ythri* stories, a type of domesticated raptor, initially used to name my convoluted Ythri presence in a version of *Star Fleet Battles* that I was playing in the early 1980s. The DH designation used more commonly in the *Albedo* scenario is merely an arbitrary term with no meaning at all.